

ADTimePix3 areaDetector driver

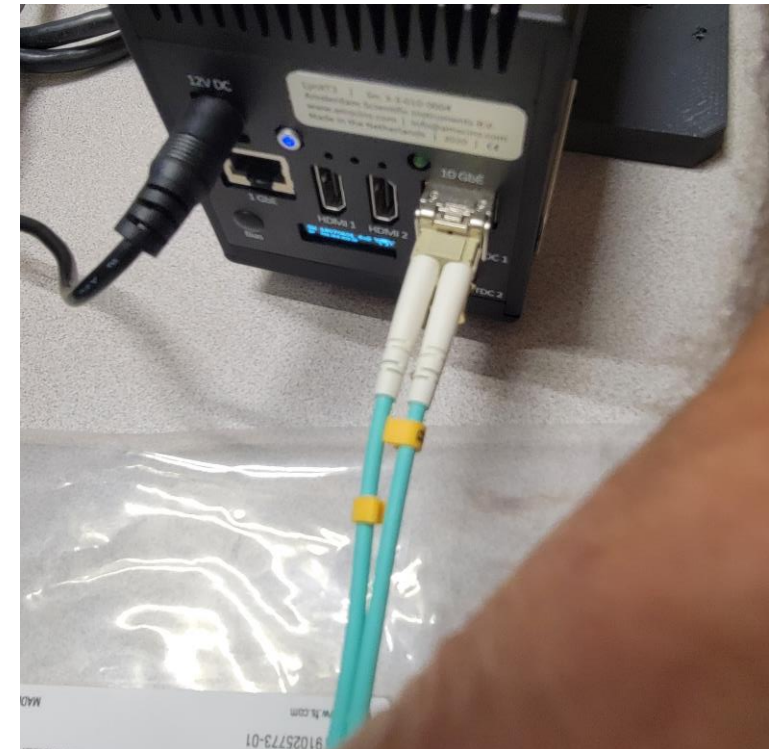
and MiniPix TPX3

Kazimierz Gofron

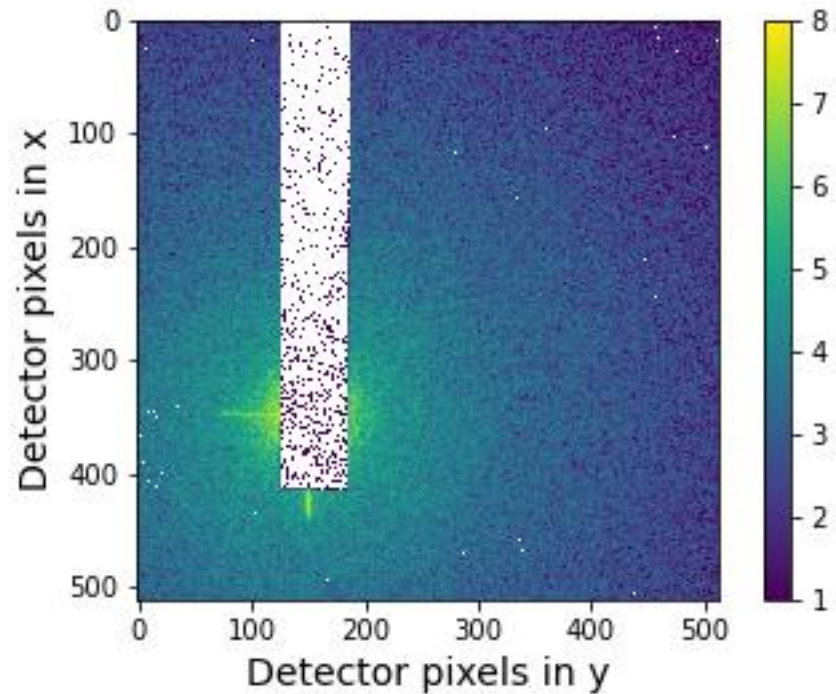
EPICS Collaboration Meeting
Ljubljana, Slovenia
September 21, 2022

ASC TimePix3

- An EPICS areaDetector driver for TimePix3 quad 512 x 512 detector from ASC.
- ASC <https://www.amscins.com/>
- NSLS2/CHX – Coherent Hard X-ray Scattering beamline
- TDC – Timing from accelerator (260 ps); DIO: 2 x 3 (timing signals)



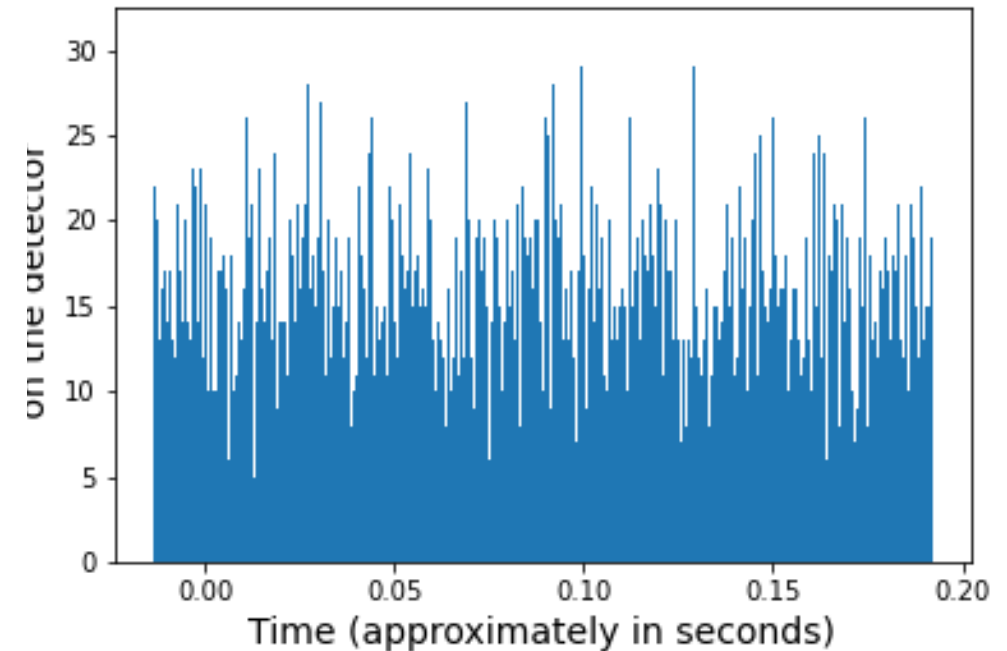
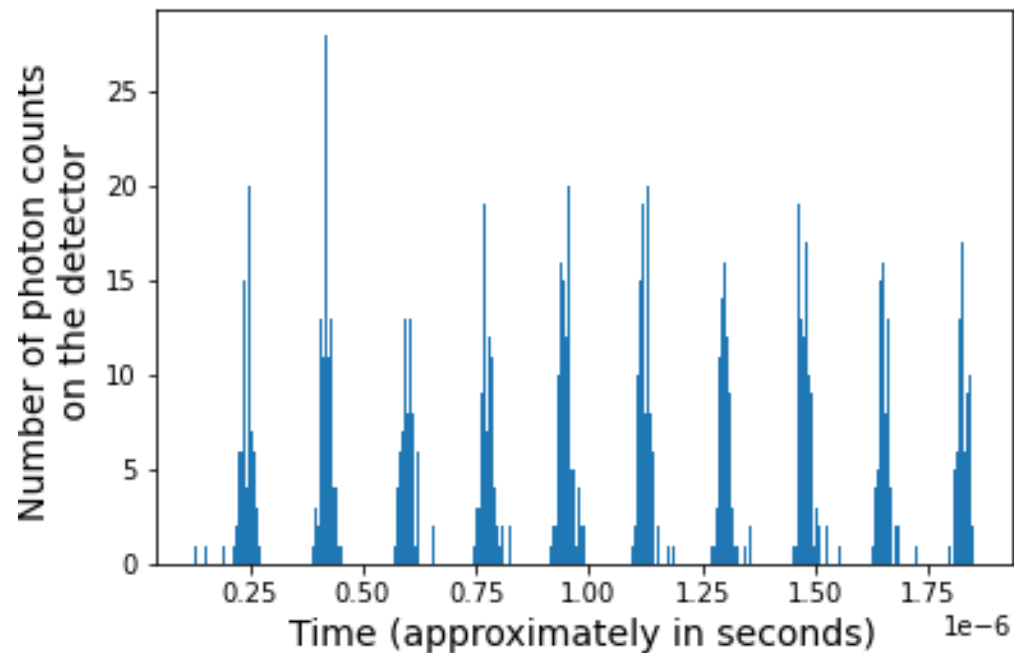
ASC TimePix3 diffraction pattern



X-ray diffraction pattern from a static ceramic sample on the Timepix single photon counting detector. Data was taken with 15 bunch mode with a ring current of 63 mA. Total exposure time = 3 seconds and the image is in log scale.

Courtesy: Chen, Xiaoqian

ASC TimePix3 timing pattern



Histograms of time stamps showing statistics of when photons arrive at detector pixels for data in Fig.1. (a) 15 bunch mode with a ring current of 63 mA. (b) Continuous filling mode with a ring current of 68 mA. Courtesy: Chen, Xiaoqian

An areaDetector driver for TimePix3 detector from ASC

- Notes

- Depends on the [CPR](#) version 1.9.1.
- Depends on the [json](#) version v3.11.2.
- Developed with ADCore R3-11 and ADSupport R1-10 or newer.
- This has only been tested on ubuntu 18.04 and 20.04 Linux 64-bit machines.
- This has only been developed for 2 x 2 chips layout, since that is what I have access to now
- This has only been tested with serval version 3.0.0.
- Driver is specific to Serval version, since features differ.

- Dependencies ([ADTimePix3/tpx3Support/](#))

- Compile cpr (<https://github.com/libcpr/cpr>)
- Clone json (<https://github.com/nlohmann/json>)

An areaDetector driver for ASC TimePix3 detector

- Json C++ library use

```
std::string config;
config = this->serverURL + std::string("/detector/config");

// Detector configuration file
r = cpr::Get(cpr::Url{config},
            cpr::Authentication{"user", "pass", cpr::AuthMode::BASIC},
            cpr::Parameters{{"anon", "true"}, {"key", "value"}});

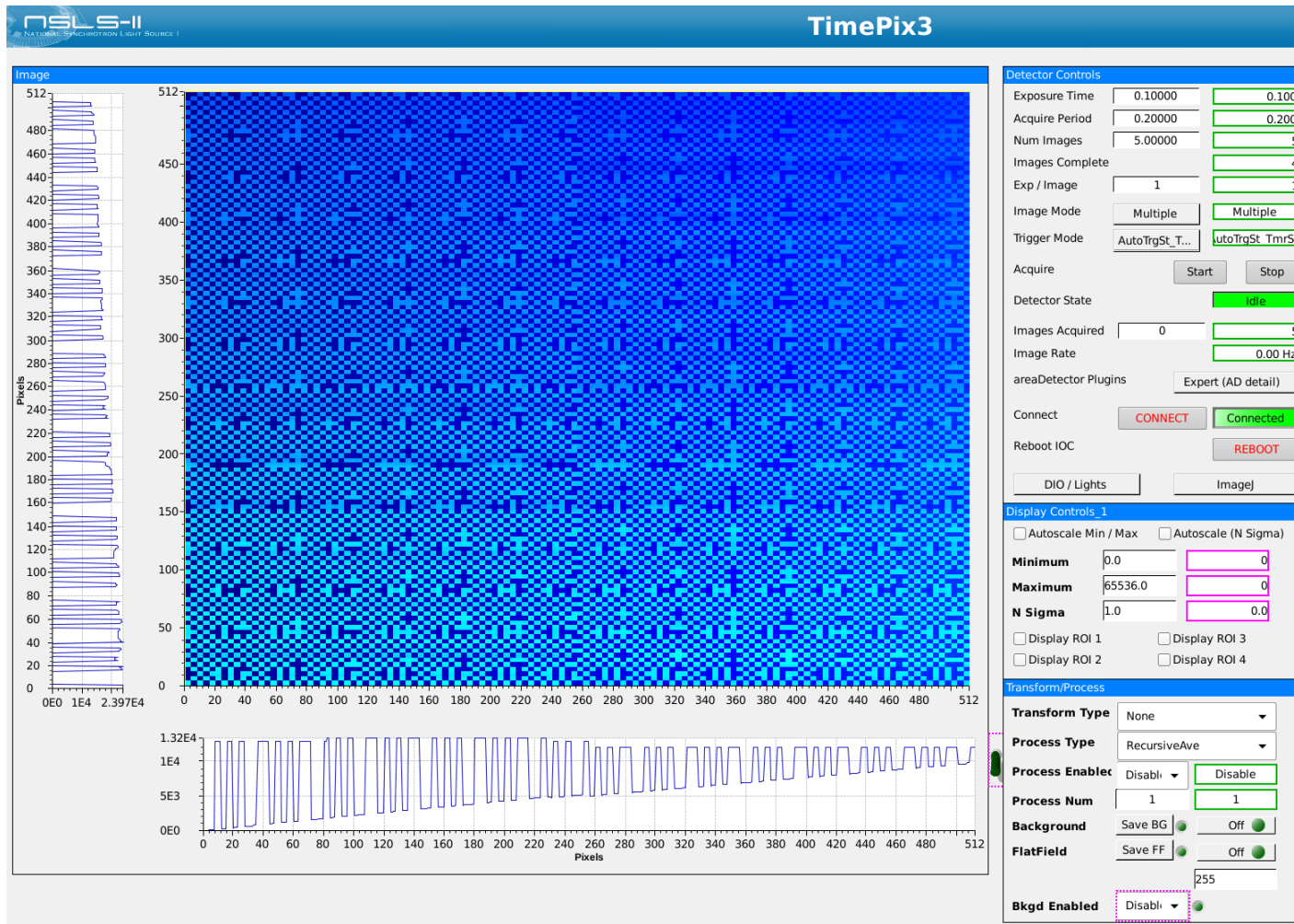
json config_j = json::parse(r.text.c_str());
config_j["BiasVoltage"] = 103;
config_j["BiasEnabled"] = true;

//config_j["Destination"]["Raw"][0]["Base"] = "file:///home/kgofron/Downloads";
//printf("Text JSON server: %s\n", config_j.dump(3, ' ', true).c_str());

r = cpr::Put(cpr::Url{config},
            cpr::Body{config_j.dump().c_str()},
            cpr::Header{{"Content-Type", "text/plain"}});

printf("Status code: %li\n", r.status_code);
printf("Text: %s\n", r.text.c_str());
```

ASC ADTimPix3 opi



The screenshot shows the TPX3-TEST:cam1 configuration window. It includes the following fields and controls:

- BPC File path: Exists: No
- BPC File name:
- DACS File path: Exists: No
- DACS File name:
- Upload BPC file:
- Upload DACS file:
- Write status code: 200
- Write message:
- Successfully uploaded detector config.

- Detector requires hardware configuration:
1. Binary Pixel Configuration file loading from CSS
 2. DACS configuration files loading from CSS

ASC TimePix3 opi

- An EPICS ADTimePix3 detector status, and FileWriter.

The screenshot displays the 'Area Detector Control - TPX3-TEST:cam1:' interface. It is organized into several panels:

- Detector Health:** Shows various temperature and speed readings (e.g., Local Temperature: 40.000, Fan1 Speed: 0.000).
- Detector config:** Contains settings for the detector, including FanPWM, BiasVoltage, ChainMode, TriggerIn, TriggerOut, and TriggerDelay.
- Detector Chip: CHIP0, CHIP1, CHIP2, CHIP3:** Each chip has a dedicated configuration panel with parameters like Ibias_CP_PLL, Ibias_DiscS1_OFF, Ibias_DiscS1_ON, s_DiscS2_OFF, Ibias_Ikrum, Ibias_PixelDAC, Ibias_Preamp_OFF, Ibias_Preamp_ON, Ibias_TPbufferIn, Ibias_TPbufferOut, PLL_Vcntr1, VPreamp_NCAS, VTP_coarse, VTP_fine, Vfbk, Vthreshold_coarse, and Vthreshold_fine. Each chip panel includes an 'Adjust' slider.
- Detector Info:** Provides details about the detector's hardware and software, such as ifaceName, ChipboardID, SW_version, FW_version, PixCount, RowLen, NumberOfChips, NumberOfRows, MpxType, and Board information.
- Detector Layout:** Shows a visual representation of the detector's layout with four chips labeled Chip0 through Chip3.
- Measurement Info:** Displays real-time measurement data like PixelEventRate, TdcEventRate, StartDate, ElapsedTime, TimeLeft, FrameCount, and DroppedFrames.

The screenshot shows the 'TPX3-TEST:cam1:' File Writer configuration interface, divided into three main sections:

- Raw File Writer:** Configures the raw data output. Parameters include Raw file path (/media/nvme/raw), Raw file pattern (%Hms_ raw%Hms_), Raw split strategy (single_file), and Raw queue size (16384).
- Image File Writer:** Configures the image output. Parameters include Image file path (/media/nvme/img), Image file pattern (%Hms_ %Hms_), Image format (tiff), Image mode (tot), Integration Size (1), Integration Mode (average), Stop On Disk Lim (true), and Queue size (1024).
- Preview File Writer:** Configures the preview output. Parameters include Preview period (0.200), Preview/sampling mode (skipOnFrame), Preview file path (/media/nvme/prv), Preview file pattern (%Hms_ %Hms_), Image format (png), Image mode (tot), Integration Size (1), Integration Mode (average), Stop On Disk Lim (false), Queue size (16), and Private Image File Path (http://localhost).

Each section has a 'Write' button and a status indicator (On/Off) with a green light.

FileWriter configuration for channels

- Raw
- Image
- Preview
 - Image
 - Histogram

ASC TimePix3 opi

- Detector configuration, and controls.

Detector config

BiasVoltage	<input type="text" value="100"/>	100
BiasEnabled	<input type="text" value="false"/>	false
ChainMode	<input type="text" value="NONE"/>	NONE
TriggerIn	<input type="text" value="0"/>	0
TriggerOut	<input type="text" value="0"/>	0
Polarity	<input type="text" value="Positive"/>	Positive
TriggerMode	<input type="text" value="AutoTrgSt_TmrSp"/>	AUTOTRIGSTART_TIMERSTOP
ExposureTime	<input type="text" value="0.100"/>	0.100
TriggerPeriod	<input type="text" value="0.200"/>	0.200
nTriggers	<input type="text" value="5"/>	5
DetectorOrientation	<input type="text" value="Disconnected"/>	UP
PeriphClk80	<input type="text" value="false"/>	false
TriggerDelay	<input type="text" value="0.000"/>	0.000
Tdc0	<input type="text" value="P0123"/>	P0123
Tdc1	<input type="text" value="P0123"/>	P0123
GlobalTimestampInterval	<input type="text" value="0.000"/>	0.000
ExternalReferenceClock	<input type="text" value="false"/>	false
LogLevel	<input type="text" value="1"/>	1

Area Detector Control - TPX3-TEST:cam1:

Setup

asyn port TPX3
 EPICS name TPX3-TEST:cam1:
 Manufacturer ASI
 Model Tpx3
 Serial number 21052719
 Firmware version 18052510
 SDK version 3.0.0
 Driver version 0.1.0
 ADCore version 3.12.1

Connection
 Debugging

Shutter

Shutter mode
 Status: Det. Closed EPICS Closed
 Open/Close
 Delay: Open Close
 EPICS shutter setup

Detector Health

Local Temperature 40.000
 FPGA Temperature 40.000
 Fan1 Speed 0.000
 Fan2 Speed 0.000
 Bias Voltage 11.9750977
 Chip Temperatures [49,46,47,46]
 VDD [1.5,0.0004,0.6]
 AVDD [1.5,0.0004,0.6]

Collect

Exposure time 0.100
 Acquire period 0.200
 # Images 5
 # Images complete 4
 # Exp./image 1
 Image mode Multiple
 Trigger mode AutoTrgSt_Tr

Acquire
 # Queued arrays 0
 Wait for plugins
 Acquire busy Done
 Detector state 0
 Status

Time remaining 0.000
 Image counter 5
 Image rate 0.00
 Array callbacks

Detector Info

IfaceName Spidr
 ChipboardID
 SW_version 21052719
 FW_version 18052510
 PixCount 262144
 RowLen 2
 NumberOfChips 4
 NumberOfRows 512
 MpxType 6
 >ards->ChipboardId 41000039
 Boards->IpAddress 127.0.0.10
 >ards->PortNumber
 Boards->Chip1 "Id":680,"Index":0,"Name":"W0
 Boards->Chip2 "Id":681,"Index":1,"Name":"W0
 Boards->Chip3 "Id":682,"Index":2,"Name":"W0
 Boards->Chip4 "Id":683,"Index":3,"Name":"W0

SuppAcqModes 63
 ClockReadout 125
 MaxPulseCount 2147483647
 MaxPulseHeight 1
 MaxPulsePeriod 34
 TimerMaxVal 34
 TimerMinVal 8E-9
 TimerStep 8E-9
 ClockTimepix 125

Readout

	X	Y
Sensor size	512	512
Binning	<input type="text" value="1"/>	<input type="text" value="1"/>
Region start	<input type="text" value="0"/>	<input type="text" value="0"/>
Region size	<input type="text" value="1"/>	<input type="text" value="1"/>
Reverse	<input type="text" value="No"/>	<input type="text" value="No"/>
Image size	512	512
Image size (bytes)	524288	
Gain	<input type="text" value="1.000"/>	1.000
Data type	<input type="text" value="UInt16"/>	-1
Color mode	<input type="text" value="Mono"/>	Mono

Detector Status

File

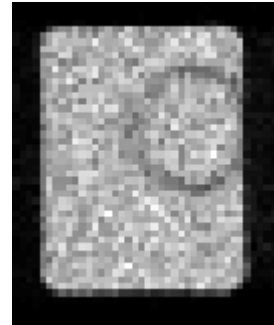
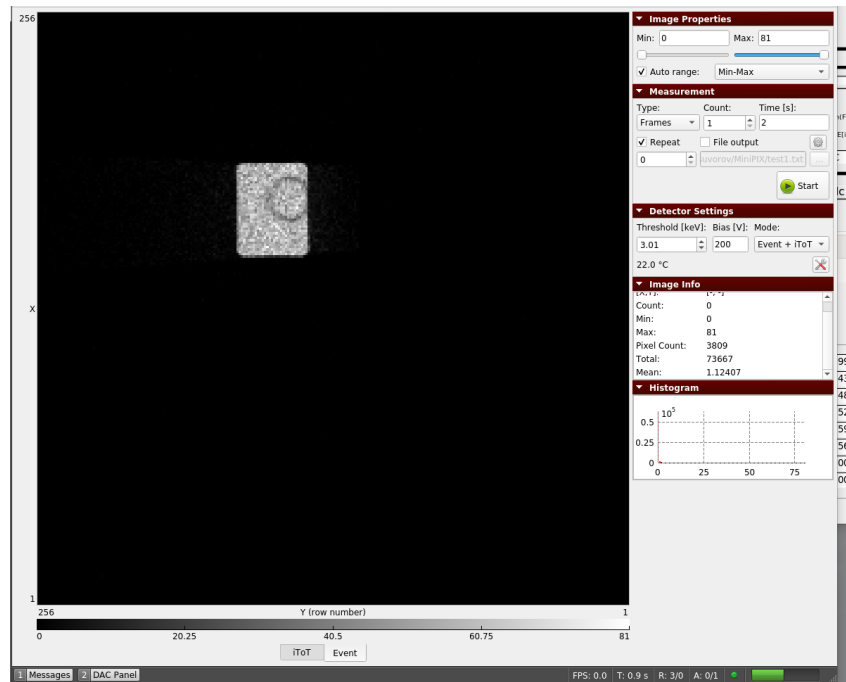
Attributes

File
 Macros
 Status File not found

ASC TimePix3 disk data structure

- Currently data written to NVME internal disk for performance
- NVME
 - Raw
 - Img
 - Prv
 - Img
 - Hst {Serval experimental version support}
- Data write rates (>> 1GB/s)
- EPICS channel used for viewing
- .tpx3 data format

Advacam MiniPix TPX3 (IXS/10ID beamline)



Analyzer Optics

Sample

CDW

Montel Mirror



MiniPix image of inelastic scattered 9.1 keV X-ray beam behind slits mounted in front of Montel Mirror.

Advacam: <https://advacam.com/>

Summary

- An EPICS ADTimePix3 areaDetector driver for 2x2 ASC TimePix3 was developed.
 - Uses Curl for human's library
 - Uses json library
 - Driver features are being added, as beamlines request their use.
 - Coordinate with ASC (Serval), and beamline scientists
- Advacam MiniPix TPX3 as replacement for ADP detector.